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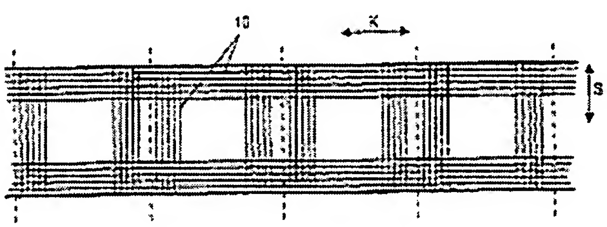
(54) Title: **INTELLIGENT LABEL**



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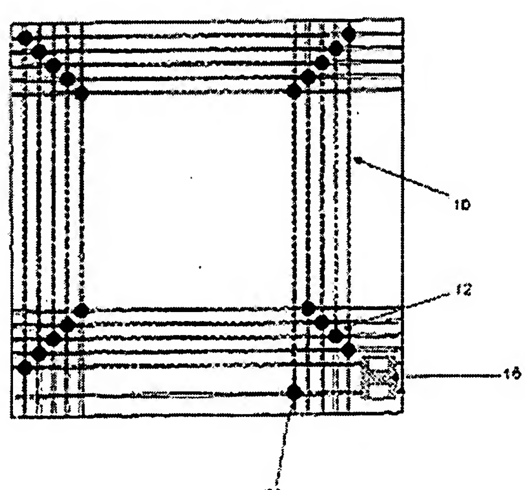

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(57) Abstract: The invention relates to a device, particularly an intelligent label, comprising: a) at least one textile support; b) at least one flexible wire-like and/or thread-like electrical conductor (10) having at least one connection point for an electronic component (16), and; c) at least one electronic component (16) that is electrically connected to the connection point of the conductor (10), whereby the conductor (10) is situated on or in the textile support.

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Intelligent Label

Description

The invention relates to a device with an electronic component in a textile environment according to Claim 1, as well as a production method of a device according to Claim 19.

"Intelligent labels", so-called smart labels, will gain considerable significance in the textile field in the future in the context of manufacturing logistics, marketing and care or cleaning of textiles. For example, intelligent labels can be equipped with non-contact, scanable transponder systems (so-called RFID tags), via which textile-specific information can be recovered. Corresponding labeling of rental linens, washing in laundry facilities or storage come to mind as preferred areas of application for textiles equipped in this way. The fact that the intelligent label is resistant to the methods ordinarily used for the production and cleaning of textile and withstands the intended use of the textile is of special significance in this context. If articles of clothing are involved in the textiles labeled in this way, they should also not reduce the wear and use comfort of the textiles.

Ordinary intelligent labels (smart labels) typically consist of a small silicon chip that contains a processor, a data transmission device (for example, a modulator) and a limited memory to accommodate specific data. An integrated coil is also provided, which, together with a capacitor and the silicon chip, forms a resonant circuit, whose resonance frequency is tuned to a specific frequency. Typically used frequencies are 13, 56 MHz and 135 kHz. The coil, which is an electrical conductor loop with one or more windings, is brought into the alternating magnetic field of a transmitting antenna for the reading process of the non-contact transponder system so that inductive coupling is built up between the transmitter and the antenna coil of the intelligent label. An electrical voltage is induced in the coil by the alternating magnetic field, which is used rectified as a voltage supply of an integrated transponder circuit (transponder ICs or RFID chips). For ordinary frequencies and admissible field intensity, loop surfaces of about 25 cm^2 and 1 to 10 coil windings are common.

This type of ordinary "intelligent label" is shown in Fig. 4. The coil 100 consists of metal conductors 102 in a planar arrangement with a spiral structure applied to a thin (not shown in Fig. 4) plastic film. The metal conductors 102 can either be printed on or etched out by a lithography step and a subsequent etching process from a copper-coated film. Typically, the patterning process is followed by a galvanic reinforcement of the conductors 102 in order to achieve a lower series resistance of coil 100. The transponder IC 104 (the so-called RFID chip) is contacted on one side of coil 100. A metal bridge (not shown in Fig. 4), which must be plated through in order to produce connection of the two coil ends with chip 104, is situated on the back side of the film.

Such ordinary "intelligent labels" suffer from the demanding patterning process, as well as the high series resistance of the coil, which results in poor quality of the resonant circuit. The planar coil also requires a relatively large surface, since the coil windings must be arranged next to each other. However, a particular shortcoming is that the coil must be applied to a support film that is relatively rigid and poorly suited for textile applications. This type of coil, which is applied to a support film, represents a foreign body in textile applications that reduces wear comfort of an article of clothing, in particular. In addition, ordinary coil systems based on a film do not have long-term stability in textile applications, since they can only withstand the typically occurring loads (for example, stretching, folding, ironing, washing cycles, temperature changes and moisture loads) to a limited degree. This type of "intelligent label" is also visible and/or palpable, which can be an interference, especially when used in articles of clothing, and which hampers use as fraud and/or theft protection, for example, in expensive brand-name clothing articles.

Non-contact transponder systems are also used in the prior art for "intelligent labels", in which the transponder IC is accommodated in a coin-like hard plastic disk in which the antenna coil is also situated. Such ordinary systems are even more poorly embedded in textile media than the foil-based systems initially described.

In view of the mentioned drawbacks of the prior art, the object of the invention is to provide a device, especially an "intelligent label" (a so-called smart label) that can be readily integrated in a textile environment and that withstands the loads occurring in it. An object of the invention is also to provide a corresponding production method for such a device.

This objective is achieved by means of a device with the characteristics of Claim 1, and by means of a method according to Claim 19. Preferred embodiments are the object of dependent claims.

According to the invention, a device, especially an "intelligent label" for textiles, comprises,

- at least one textile support;
- at least one flexible wire- and/or thread-like electrical conductor that has at least one connection point for an electronic component; and
- at least one electronic component that is electrically connected to the connection point of the conductor;

in which the conductor is arranged on or in the textile support.

According to the invention, the conductor, which can be a spiral-like antenna coil of a transponder system, is therefore flexible and has a wire- and/or thread-like structure. These flexible properties of the conductor enable it to be directly arranged in or on a textile support. In contrast to the known "intelligent labels", the device according to the invention is not a foreign element in a textile environment, since a support film and a hard housing need not be used. A device according to the invention therefore has significantly improved wear comfort, as well as more advantageous stress properties, in comparison with the usual "intelligent labels" described at the outset.

The textile support is preferably a fabric. Fabric in this context is understood to mean a planar textile fabric consisting of two thread systems intersecting at right angles, which are referred to, as usual, as the warp and weft. The warp lies in the longitudinal direction of the weaving process, while the weft runs across the direction of weaving. The textile support can be a fabric section, which can be applied to a textile being labeled together with the conductor or conductors

arranged on or in it. As an alternative, the textile support can also be the textile itself, which is to be provided with a device according to the invention.

According to a preferred embodiment of the invention, the fabric has at least one electrically conducting weft and/or warp thread and the conductor includes at least one electrically conducting weft and/or warp thread of the fabric. In this case, the conductor is arranged in the textile support and itself represents part of the fabric, of which the textile support consists. Owing to the fact that the conductor, which can be an antenna coil for a transponder IC, for example, is a component of the textile support itself, this type of device according to the invention can be embedded particularly well in a textile environment.

The conductor preferably comprises at least one electrically conducting weft and at least one electrically conducting warp thread, which are connected to each other electrically conducting at their intersection points. For example, two wiring planes, independent of each other and running perpendicular to each other, can be provided in a simple textile fabric structure by corresponding electrically conducting weft and warp threads that can be connected electrically to each other at their intersection points. The contacting process of a weft thread with a warp thread at their intersection points can occur, for example, by means of a die or roll, especially by a melting, soldering or gluing process. By appropriate electrical connections of the warp and weft threads, a complex trend of the electrical conductor can therefore be produced simply in the fabric.

The conductor preferably comprises a number of electrically conducting weft and warp threads that are partially connected electrically conducting at their intersection points, so that the conductors form an electrically conducting coil. A coil like this, arranged in the textile support, typically has a rectangular spiral shape and represents a planar conductor arrangement. The electrically conducting weft or warp threads are preferably enclosed by an insulation sheath, so that undesired short circuits can be avoided at the intersection points of the weft and warp in a simple way. By choosing an appropriate point contacting pattern of the warp and weft threads, the problem of "back wiring" that occurs in ordinary, film-based planar coils can be solved in simple fashion without bridges. Although an essentially planar conductor arrangement is

involved, as in the prior art, unlike the film-based coils, no bridges are required for feedback to the exterior (or vice versa) of the contact lying within the spiral.

The conductor preferably has two connection points forming the coil connection, which are connected electrically to the electronic component. The connection points of the conductor can be weft and/or warp threads, which are connected, for example, by a soldering or gluing step to the contact surfaces of the electrical component.

The electrically conducting weft and/or warp thread preferably is electrically conducting yarn, consisting of electrically insulating fibers and at least one metal wire embedded or spun into it. As an alternative, the electrically conducting weft and/or warp threads can also consist directly of a thin metal wire, for example, a copper wire. Such spun metal wires, optionally with insulating fibers, are more robust and more flexible than conductors printed on a film. In addition, metal threads or wires that are specified for the special environmental conditions of textiles relative to their surface treatment can be advantageously produced. Especially in comparison with coils produced with the printing method, metal wires generally have higher electrical conductivity.

Another advantage, in comparison with coils structured by the etching process on films, is also the lower metal consumption when metal wires are being used. When conductors are produced by means of an etching process, a large part of the metal layer must be removed in order to achieve a definition of the metal conductor and must be recovered from the etching solution, which involves a cost. For example, if the conductor is a spiral-shaped coil for an antenna coil of a transponder IC, a coil with comparable inductance, but significantly increased quality can be produced by means of the invention. The metal wire preferably has an electrically insulating sheath.

According to another preferred embodiment, the conductor is not arranged in the textile support, but on it. For this purpose, the conductor preferably has a metal wire that can have an electrically insulating sheath.

The conductor is preferably an electrically conducting yarn, consisting of electrically insulating fibers and at least one metal wire embedded or spun into it. This type of conductor is somewhat more voluminous, because of the additional textile threads, but also acquires a stronger textile character. When connected to the electronic components, it must be kept in mind in this case that the (not electrically conducting) textile threads do not interfere with the contacting on the metal wires.

The conductor is preferably joined to the textile support by a glue bond. The textile support, in particular can be coated with a glue, for example, a hot-melt adhesive, which preferably permits ironing on of the conductor. If the conductor is an electrically conducting yarn, this can optionally be additionally provided with an adhesive, in which case it is impregnated with an adhesive.

The conductor can be an electrically conducting coil that is wound spiral-like around a hollow element and positioned on the textile support and fixed.

A second textile support can advantageously be arranged on the first textile support, so that the conductor is embedded between the supports. This joining of two textile supports with the electrical conductor arranged in-between provides for a particularly efficient mechanical protection of the conductor, as well as a high loadability of the device according to the invention. The electronic component is also preferably arranged between the two textile supports.

The electronic component can be an integrated circuit (IC), especially a transponder IC (so-called RFID chip). In conjunction with a conductor that represents a spiral-shaped electrically conducting coil, a non-contact, readable transponder system can be prepared that can be integrated excellently into a textile environment.

The electronic component is preferably embedded in an insulator and applied to the textile support. Expediently, a water-tight and soft material is used in the insulator.

According to the invention, a method for the production of the device, especially one of the aforementioned devices, comprises the steps:

- preparation of at least one textile support, on or in which at least one flexible wire- and/or thread-like electrical conductor is arranged, the conductor having at least one connection point for an electronic component;
- electrical joining of the connection point of the conductor to at least one electronic component.

The textile support is preferably a fabric and the conductor has a number of electrically conducting weft and warp threads, in which case the method includes the step of the electrical joining of at least one weft with one warp thread at their intersection point. As an alternative, the conductor can be joined to the textile support by a glue bond.

Relative to ordinary "intelligent labels" a device according to the invention enjoys the following advantages:

- The electrical conductivity of a metal wire in the electrically conducting wire- and/or thread-like conductor is higher than that of the ordinarily used conductors on a plastic film. This manifests itself, for example, in a higher quality of an antenna coil that can be formed by the conductor.
- A material loss that is inherently associated with the production process of an ordinary antenna coil does not occur in the case of the production method according to the invention.
- If the conductor is to be used in the form of a coil, a device according to the invention permits the coil connections to be brought out without "back-contacting" with the help of a bridge, as was necessary in ordinary coils.
- In contrast to ordinary devices, no substrate film is necessary, on which the otherwise conventional thick layer processes were applied.
- The production method according to the invention can be unwound from spindles with a high degree of parallelism.
- The textile label can be embedded excellently in a textile environment and comfortably worn, washed and ironed.

- When a laundry or manufacturer label is used as support for the conductor, no additional textile support is necessary

The invention is described below with reference to preferred practical examples by means of the accompanying drawings. In the drawings:

Fig. 1(a)	shows a schematic view of an endless fabric web, in which thread-like conductors are introduced in the warp direction, as well as with a specific repeat in the weft direction;
Fig. 1(b)	shows a schematic view of a cutout from the fabric web depicted in Fig. 1(a), in which the thread-like conductors form an electrically conducting coil by means of local contacting;
Fig. 2(a)-(d)	shows schematic views of the contacting method of a wire- or thread-like conductor on the contact surfaces of an electronic component;
Fig. 3	shows schematic views of the contacted electronic component cast in an insulator; and
Fig. 4	shows an ordinary "intelligent label" with a metal conductor coil on a film base.

Fig. 1 schematically depicts an endless fabric web, in which wire-like or thread-like conductors 10 are woven in on a ribbon weaver. These electrically conducting threads extend both in the warp direction K (longitudinal direction) and with a certain repeat in the weft direction S (transverse direction). This arrangement can also be produced two-dimensionally on a flat mechanical loom. Each of the conductors 10, indicated by a black line, can consist of one or more conducting threads. The conductors 10 can also be yarns, in which a thin metal wire is spun with at least one insulating fiber, for example, an artificial fiber. As an alternative, a thinner metal wire can also be used directly as wire-like conductor.

A cutout from the endless web depicted in Fig. 1(a) is shown in Fig. 1(b). By means of appropriate local contactings 12, which are shown schematically in Fig. 1(b) as black points, the electrically conducting weft and warp threads 10, running one over the other, can be joined at the intersection points. The contactings 12 of the individual electrical conductors 10 can be

embossed, for example, by a die or roll, especially by melting, soldering or gluing of the metal conductors 10. A spiral-like conductor is formed by means of contactings 12 in Fig. 1(b), which has a planar coil structure. For a better explanation of the electrical conduction path, the coil in Fig. 1(b) is emphasized with the help of a dashed line.

Two conductors, one weft and one warp thread 10, are accordingly connected to each other by the 4 × 5 contactings 12, so that a spiral-like current path is formed through the fabric. With the help of additional contactings 14, the current path can be brought out from the interior of the coil without a bridge being necessary as "back-wiring" device, as in the prior art. The conductor pieces of conductors 10 protruding laterally from the coil have no effect, since their ends are open and no current can flow. If desired, the edges of the fabric can be additionally insulated, which can occur, for example, by means of sealing or melting. In addition, optionally, conduction sections that are not required, can be separated with a blade or punch. A transponder IC (RFID chip) is connected at the connection points of conductor 10, which, in this case, represent the connections of the electrically conducting coil.

In the embodiment of a device according to the invention just described, the conductor 10 is arranged in the textile support, in which electrically conducting weft or warp threads of the textile support consisting of a fabric are used as conductor 10. As an alternative, however, it is equally possible to produce the conductor from a thin, flexible, wire- and/or thread-like material that is electrically conducting. This type of conductor is arranged in a subsequent production step on the textile support by means of a gluing step. For this conductor, a thin coil wire is particularly well suited, for example, a copper wire, which is sheathed with silver and insulating enamel, as produced and used for ordinary coils and transformers.

In order to produce an antenna coil for a transponder IC, this type of thin coil wire is preferably wound around a hollow element, in which the wire beginning and end are clamped by means of a retaining device. Immediately thereafter, the wire beginning and end are connected in an electrically conducting fashion to the transponder IC, as will be described in detail later. The transponder IC can be cast with a drop of insulating, wash-proof and temperature-resistant plastic and then placed, by means of stripping it off from the winding device, on the textile support,

which was coated, for example, with hot-melt adhesive for textiles. The transponder IC with the coil is fixed on the textile support with the help of a brief heating and the application of pressure. The textile support with the "intelligent labels" produced in this manner can then be ironed into the textile and assume its function. After the process of being ironed onto the textile, in which an article of clothing or article of washing can be involved, the coil with the transponder IC is protected on both sides by textile fabric and no longer needs any additional encapsulation.

It is also possible to wind the coil from a textile thread, in which a metal wire has been spun. The coil becomes somewhat more voluminous on this account, but acquires a stronger textile character. In this case, during connection to the chip, it must be kept in mind that the textile thread must not interfere with the contacting on the metal wire. Optionally, it is even possible to impregnate the thread with the textile adhesive and to accomplish the joining of the individual conductors to each other and to the textile support via the thread.

Coil wires have been shown to be particularly suitable for the employed thin metal wires, for example, the coil wire TW-D with a diameter of 40 μm from Elektro-Feindraht AG, Eschholzmaat, Switzerland. This copper wire is silver plated and provided with a polyamide insulation coating. It is specially tested for textile applications and has been shown to be washable and resistant to dry cleaning and temperatures up to 100°C.

In order to produce inductance corresponding to an ordinary "intelligent labels" according to Fig. 4, this type of wire is preferably wound on a winding device. The winding device can be a cuboid element with an edge length of 2.7 cm or a round cylinder with a diameter of 3.04 cm, on which seven windings of copper wire are wound. The winding device has two clamps, with which the wire beginning and end can be fastened.

The transponder IC is contacted to the wire ends on the winding device itself, which is shown in Figures 2(a) to (d). This advantageously occurs by providing the contact surfaces of the transponder IC 16, as shown in Fig. 2(b), with a low-melting soldering paste 20. The soldering paste 20 can consist of soldering beads and a flux. PbAgSn is suitable, in particular, as the solder. The connection points of conductor 10 are then arranged on the contact surfaces 18 so

prepared of transponder IC 16 and heated, for example, with a gas flame, a laser or a light beam, until the solder melts and bonds to wire 10. The employed conductor 10 has an insulation sheath 22, which is removed under the influence of heat (shown schematically in Fig. 2(c) as lightning). During the positioning and joining process, the conductor 10 is held by means of retaining clamps 24 relative to the contact surfaces 18 covered with solder paste. The result of the electrical and mechanical fixation by means of the heating process is schematically depicted in Fig. 2(d).

The transponder IC so contacted is then encapsulated by means of a drop-wise application of a casting mass 26, which renders the chip wash-proof and ironing-resistant and mechanically protects the chip. A water-tight and soft insulator is particularly well suitable for casting mass 26. The wound coil wire 10, together with the transponder IC 16 prepared in the described manner, is stripped off from the winding device and placed on a textile support, which is preferably coated with a layer of hot-melt adhesive for textiles. With the help of a brief heating and the application of pressure, the loosely wound coil with the chip is fixed on the textile support. The preferred device according to the invention prepared in this manner can now be ironed onto an article of clothing or other textile. The coil with the transponder IC is then protected on both sides of the textile, and also withstands larger mechanical loads. The employed conductor, preferably a coil wire, is flexible, so that it can adapt well to the fabric and cannot be kinked.

The device according to the invention, with particular preference, is inserted into a manufacturer or material label flap already applied to the article of clothing, which was coated on the inside surfaces with textile adhesive. The coil with the transponder IC can be affixed in the label flap with the help of a pressure and heating process.

List of reference numbers

10 Wire- or thread-like conductor

12 Contactings of intersecting conducting weft and warp threads

14	Contacting to bring out the internal coil connection
16	Electronic component, for example, a transponder IC or RFID chip
18	Contact surfaces of the electronic component
20	Solder paste with soldering beads and flux
22	Insulation sheath of the conductor
24	Retaining clamps or jaws
26	Casting mass (soft and water-proof insulator)
K	Warp threads of the fabric or textile support
S	Weft threads of the fabric or textile support

Claims

1. A device, especially an intelligent label, with
- at least one textile support;
- at least one flexible wire- and/or thread-like electrical conductor (10), which exhibits at least one connection point for an electronic component (16); and
- at least one electronic component (16) that is electrically connected to the connection point of the conductor (10), in which case the conductor (10) is arranged on or in the textile support.

2. The device according to Claim 2, in which case the textile support is a fabric.

3. The device according to Claim 2, in which case the fabric has at least one electrically conducting weft and/or warp thread (S, K) and the conductor (10) comprises at least one electrically conducting weft and/or warp thread (S, K) of the fabric.

4. The device according to Claim 3, in which case the conductor (10) comprises at least one electrically conducting weft thread and at least one electrically conducting warp thread (S, K), which are connected in an electrically conducting fashion at their intersection point.

5. The device according to Claim 4, in which the conductor (10) comprises a number of electrically conducting weft and warp threads (S, K), which are connected partly at their intersection points (12, 14) in an electrically conducting fashion, so that the conductor (10) forms an electrically conducting coil.

6. The device according to Claim 5, in which case the conductor (10) exhibits two connection points forming coil connections, which are electrically connected to the electronic component (16).

7. The device according to one of the Claims 3 to 6, in which case the electrically conducting weft and/or warp thread (S, K) is an electrically conducting yarn, consisting of electrically insulating fibers and at least one metal wire embedded in it.

8. The device according to Claim 7, in which case the metal wire exhibits an electrically insulating sheath (22).

9. The device according to Claim 1 or 2, in which case the conductor (10) exhibits at least one metal wire.

10. The device according to Claim 9, in which case the metal wire (10) exhibits an electrically insulating sheath (22).

11. The device according to Claim 9 or 10, in which case the conductor (10) is an electrically conducting yarn that consists of electrically insulating fibers and at least one metal wire embedded in it.

12. The device according to Claims 9 to 11, in which case the conductor (10) is joined to the textile support by means of a glue bond.

13. The device according to Claim 12, in which case the textile support is coated with an adhesive, preferably a hot-melt adhesive.

14. The device according to Claims 11 and 12 or 13, in which case the electrically conducting yarn is provided with an adhesive.

15. The device according to Claims 9 to 14, in which case the conductor (10) forms an electrically conducting coil.

16. The device according to Claims 9 to 15, in which case a second textile support is arranged on the first textile support in such a manner that the conductor (10) is embedded between the supports.

17. The device according to one of the preceding claims, in which case the electronic component (16) is an integrated circuit, especially a transponder IC.

18. The device according to one of the preceding claims, in which case the electronic component (16) is embedded in an insulator (26) and is arranged on the textile support.

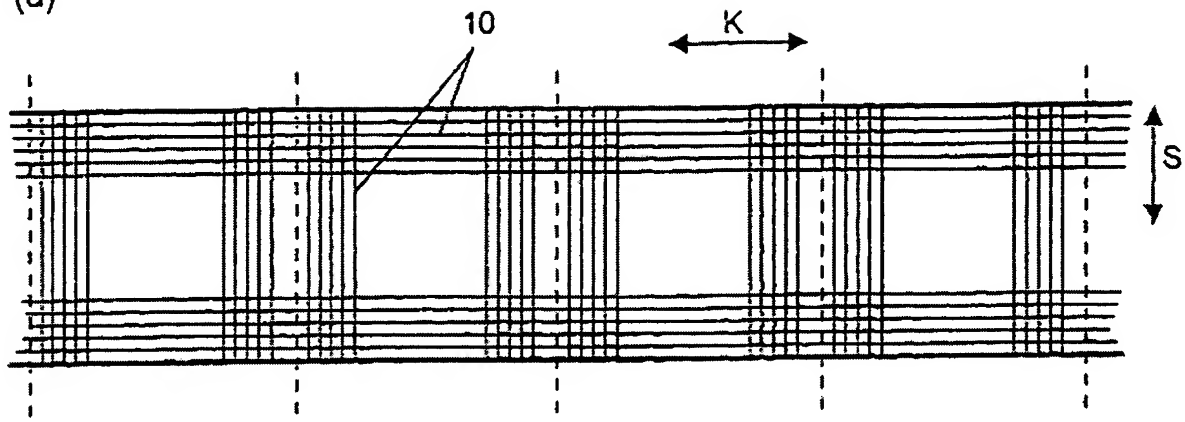
19. A method for the production of a device with the steps:

- preparation of at least one textile support, on or in which at least one flexible wire- and/or thread-like electrical conductor (10) is arranged, in which case the conductor exhibits at least one connection point for an electronic component (16);
- electrical connection of the connection point of the conductor (10) to at least one electronic component (16).

20. The method according to Claim 19, in which case the textile support is a fabric and the conductor (10) exhibits a number of electrically conducting weft and warp threads (S, K), and the method comprises the step of the electrical joining of at least one weft thread to one warp thread (S, K) at their intersection point (12, 14).

21. The method according to Claim 19, in which case the conductor (10) is bonded to the textile support by means of a glue bond.

(a)



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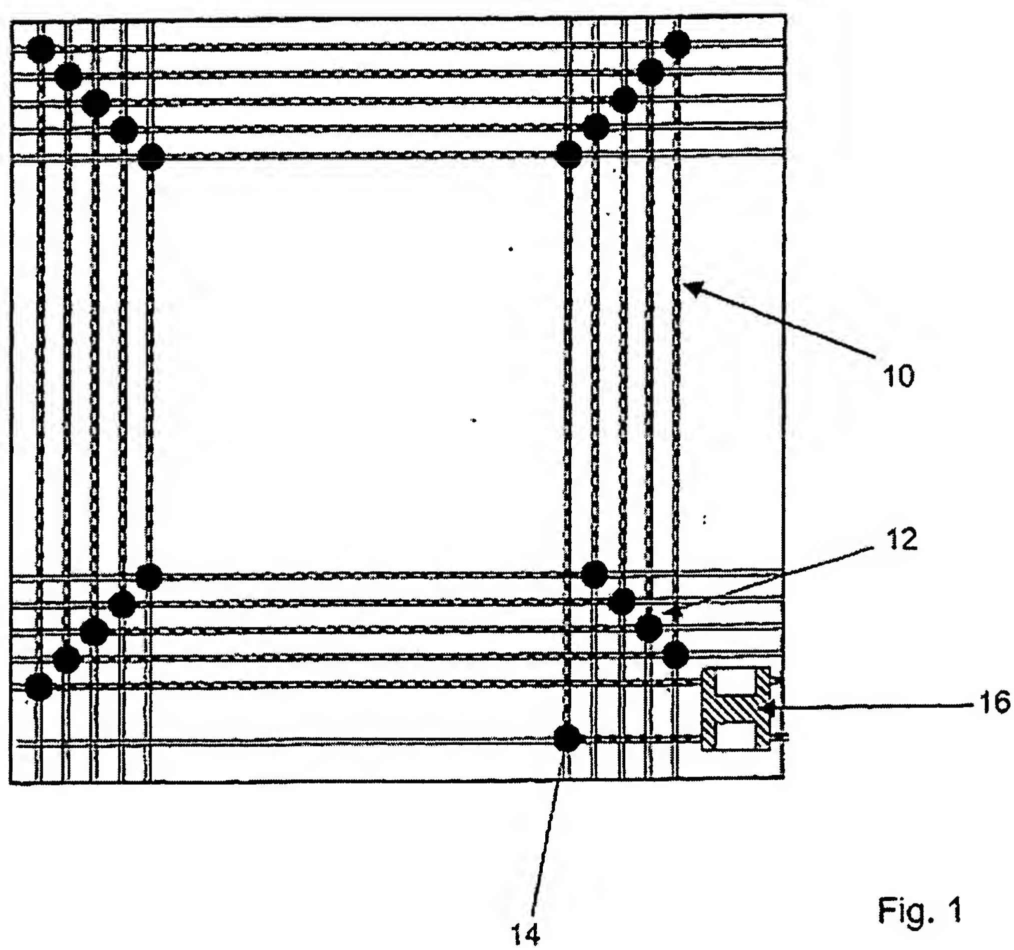

Fig. 1

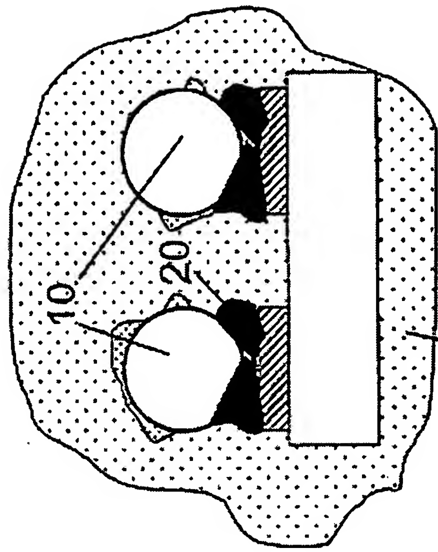

Fig. 3

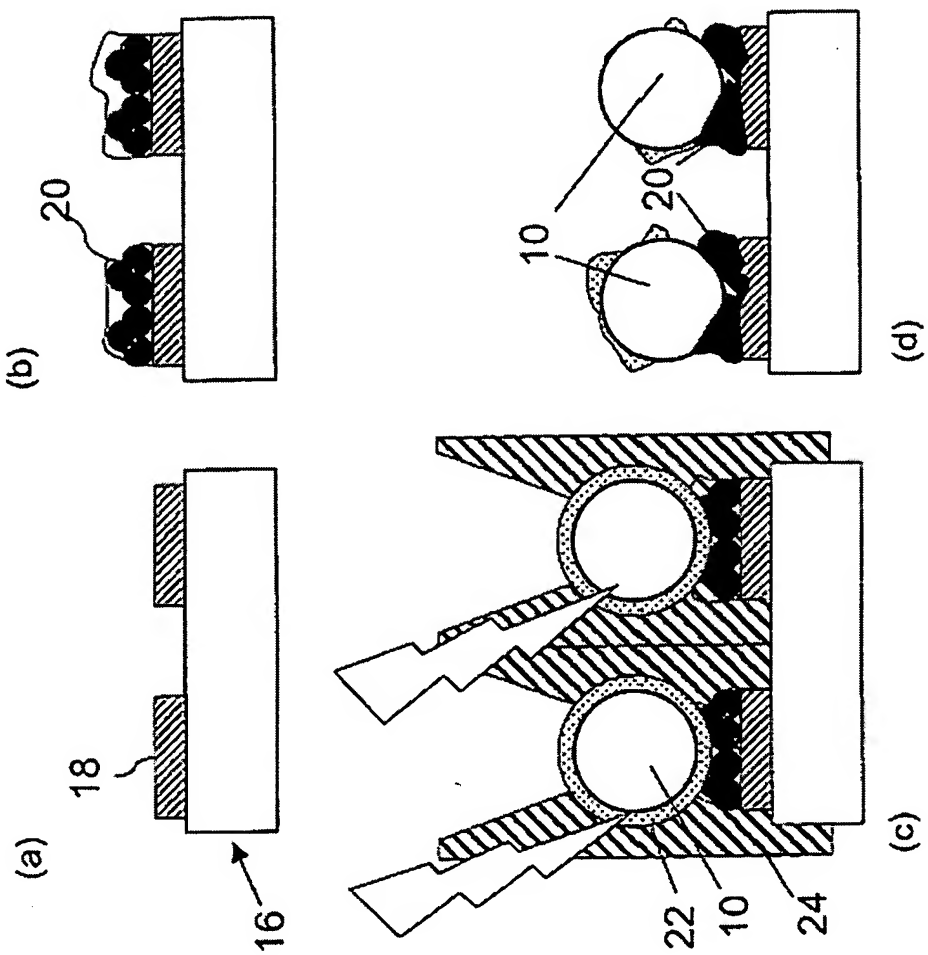

Fig. 2

Prior

Art

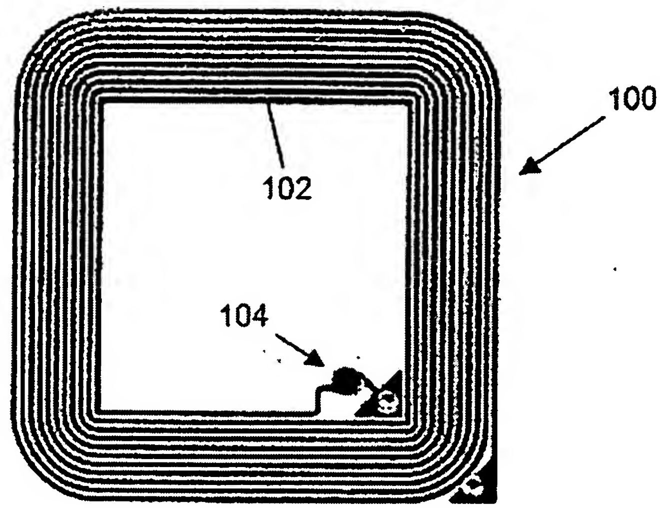

Fig. 4